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DODDER

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DODDER is a parasitic plant, infesting clover and alfalfa chiefly. It is a bad weed in Europe, though conditions in the United States are not as favorable as in Europe for damage by dodder; hence the appearance of the pest on the farm should not occasion undue alarm. Nevertheless, dodder may cause a great deal of damage, and it should not be allowed to grow unmolested.

Dodder is usually introduced on the farm by impure seed. Other means are infested hay; moving objects, such as animals and wagons; irrigation water carrying seeds and pieces of stem; and viable dodder seeds contained in stable manure.

Dodder seed, with the exception of that of large-seeded dodder, may be cleaned from impure clover and alfalfa seed by screening. It is practically impossible to remove large-seeded dodder by screening. The seeds of field dodder are also difficult to remove entirely from clover and alfalfa seed.

During the first season of infestation in clover or alfalfa, dodder usually occurs in small scattered areas. Such infested areas should be either mowed and removed before the dodder matures seed or else burned in the field. If seed has formed, burning is the only remedy, since it kills not only the plants but also any seeds of dodder which may be lying on the soil surface.

If the infestation is so great that patch treatment is impracticable, the crop may be either plowed under or utilized for hay and the aftermath closely grazed to prevent seed from forming. Sheep are especially useful in grazing dodder. If dodder seed has formed and the crop has been very seriously damaged, the safest method is to cut the crop, allow it to dry, and burn it in the field.

Dodder does not attack cereals; consequently oats, wheat, etc., should be incorporated in the rotation following the infestation of the soil with dodder seeds. A tilled crop, such as corn, will cleanse the soil of most of the dodder seeds. In place of clover or alfalfa, other legumes, such as soy beans, velvet beans, and cowpeas, may be grown, since dodder never damages any of these crops. The seeds of dodder in the soil may remain viable for a period of five years or longer.

A number of cultivated crops besides clover and alfalfa are subject to dodder infestation; the most important of these are sugar beets, onions, and flax.

Contribution from the Bureau of Plant Industry

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DODDER.

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THE NOXIOUS CHARACTER OF DODDER.

DURING RECENT YEARS an increasing number of complaints of dodder, or love vine, have been received from all parts of the United States. The weed seems particularly troublesome in southern California, Virginia, Utah, Kentucky, and Colorado and in all regions in which clover and alfalfa are raised for seed. Although a noxious weed, dodder is not to be feared in the United States in the same degree that it is dreaded in Europe. In parts of Europe, especially in certain regions of Germany, the production of clover seed has ceased because of the ravages of dodder. The conditions in this country do not seem to be as favorable as in Europe for the development of dodder; hence the discovery of dodder on the farm should not be the occasion for serious alarm but rather for the employment of a well-conceived and systematic plan for its extermination. Eradication is not difficult if intelligent thought and action are devoted to the problem. Dodder has been more legislated against than any other weed, with the possible exception of Canada thistle.

COMMON NAMES OF DODDER.

As with all our troublesome weeds, the common names by which dodder is known vary according to locality. These various names in different parts of the country are frequently descriptive of the characteristics of the plant. These common names, in addition to dodder and love vine, which are most frequently used, are strangleweed, devil's-guts, goldthread, pull-down, devil's ringlet, hellbind, hairweed, devil's-hair, and hailweed. The plant upon which dodder grows is called the host. For example, flax is the host for flax dodder and clover the host for clover dodder.

DESCRIPTION OF DODDER.

When large enough to become noticeable, dodder is a slender twining parasite. (Fig. 1.) The tough, curling, threadlike, leafless stems (fig. 2) are usually yellowish or of orange color, but they are sometimes tinged with red or purple and occasionally are almost white. Close examination of the stem will reveal minute scales, the rudiments of leaves.

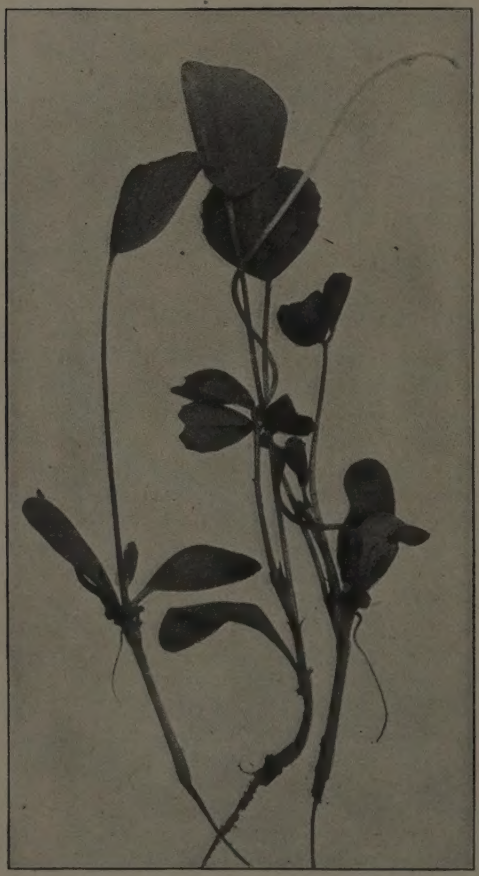

FIG. 1.—Young alfalfa seedlings attacked by alfalfa dodder. Note especially how the lower portions of the dodder stems have withered and died, thus losing connection with the ground.

The tiny flowers occur in massed clusters (fig. 3) from early June until frost. They may be white, pink, or yellowish, and the ordinary flower parts are barely visible to the naked eye. The tiny gray to reddish brown seeds are produced in abundance, a single plant being capable of maturing upward of three thousand. Seeds ripen from July until frost. In occasional adverse seasons no flowers are formed.

Usually during the first season of infestation, dodder is noticeable in the field in the form of scattered yellowish areas. If allowed to produce seed and clover or alfalfa is grown the second season, so much dodder will frequently be present that the entire field will turn yellowish, the color of the dodder predominating over that of the leguminous crop.

SPECIES OF DODDER AND PLANTS WHICH THEY ATTACK.

Altogether about 50 species of dodder are found in America, about 32 of which are native. Usually the native dodders are not as troublesome as the introduced species. The field dodder,[1] one of our troublesome native species, now occurs in Europe. The several species of dodder are very similar in appearance, and an expert is required to distinguish one from another. For this reason, no attempt will be made to describe the different species.

It is important to know, however, that some of the dodders show marked preference for certain crops; as, for example, the small-seeded alfalfa dodder, which is practically never very harmful on

FIG. 2.—Branches of clover infested with dodder.

any crop except alfalfa, though it may grow on other plants. Again, flax dodder in its growth is practically restricted to the flax crop.

Conspicuous exceptions to this rule are the common dodder and the field dodder, which seem indifferent as to their hosts, attacking plants as diverse as ragweed and onion. None of the dodders affect oats, wheat, or other cereal crops.

A knowledge of the species infesting a crop is frequently of practical importance. For example, clover dodder[2] rarely seeds in the United States; hence it is to be feared only during the first season after sowing and not thereafter, although under favorable conditions it may live over by means of stems. Again, the large-seeded alfalfa dodder is damaging usually to alfalfa only and ordinarily will not seriously harm clover. Furthermore, it is important to be able to recognize the various species of dodder by means of the seed found as impurities in commercial seed. Thus, the small-seeded

[1] *Cuscuta arvensis.* [2] *Cuscuta epithymum.*

alfalfa dodder causes damage throughout the West, but is not to be feared in the East. It is suggested that, in order to determine species, either the seeds found in commercial seed or specimens of flowers collected in the field be sent to the State agricultural experiment station or to the United States Department of Agriculture for identification.

FIG. 3.—The specimen at the right shows dodder in flower, while the one at the left shows dodder in fruit. The host plant is red clover.

The species of dodder which are most damaging in the United States and their host plants are described in the following paragraphs:

Small-seeded alfalfa dodder.[3]—The small-seeded dodder was introduced from southern Europe and occurs in the West, but is not found in the East. It attacks a number of plants, but is particularly troublesome in alfalfa.

Field dodder.[4]—Unlike most species, field dodder shows little preference as to the plants which it attacks, since it will grow on leguminous crops and wild plants with equal facility. The stems of this species are pale yellow in color, a characteristic which is useful when determining the species in the field. Field dodder is a native species, growing in most parts of the United States, but causing the greatest damage east of the Mississippi River. During certain seasons when climatic conditions are favorable for its development, this species is unusually prevalent. Its seed is a common impurity in commercial seed, and this species is one of the most destructive of all the dodders.

Clover dodder.[5]—Clover dodder shows a decided preference for clover and alfalfa. It is an introduced species, occurring in parts of the West and found in the East from Maine to Pennsylvania. Its maximum damage occurs during

[3] *Cuscuta planiflora.* [4] *Cuscuta arvensis.* [5] *Cuscuta epithymum.*

the first year in fields planted with imported seed, since it rarely seeds in the United States. The stems of clover dodder are distinctly reddish in color.

Large-seeded alfalfa dodder.[6]—The large-seeded dodder attacks a number of plants, but exhibits a decided preference for leguminous crops, particularly alfalfa. It is a native species, common westward, rarely found in the East, and but occasionally in the South.

Common dodder.[7]—The common dodder resembles the field dodder in its indifference to the plants which it may attack. It is usually the species complained of as attacking garden ornamentals, and it may even infest hedges and willows. It is native in the United States.

Chilean dodder.[8]—Chilean dodder attacks clover and alfalfa. This is a common South American species which was introduced into the Mississippi Valley and California, where it caused some loss. It has been little feared during recent years, although the seeds of this species are frequently found in red-clover and alfalfa seed from South America.

Dodder is of economic importance principally because of the damage it causes in clover and alfalfa. For this reason the term "dodder," as used in the following pages, refers to clover and alfalfa dodders unless otherwise specified.

Dodder is a parasite. Soon after it establishes connection with a host plant (usually clover or alfalfa), dodder loses its hold on the ground and lives entirely on the host.

LIFE HISTORY OF A SINGLE DODDER PLANT.

As an example to illustrate the life history of a single dodder plant, we may select clover dodder.[9] All dodders reproduce from seed. (Figs. 4, *a*, and 5.) The tiny seed germinates (fig. 4, *b*), using all its stored-up food in the production of a slender yellowish shoot, somewhat resembling a bent toothpick. (Fig. 4, *c*.) This leafless, almost rootless, stem rotates until it comes in contact with a congenial host, such as clover. (Fig. 4, *d*.) With some species of dodder the seedling may attack almost any plant growing in the field, but will leave this temporary host as soon as it can climb within reaching distance of near-by clover or alfalfa. In case suitable contact is not established, the temporary stem lies dormant on the soil for four or five weeks and then dies.

If a suitable host is encountered, the tiny stem immediately begins to climb by encircling the host plant. (Figs. 1 and 4, *e*.) Let us say,

[6] *Cuscuta indecora.*
[7] *Cuscuta gronovii.*
[8] *Cuscuta racemosa chilcana.*
[9] In figure 4 alfalfa is shown as the host.

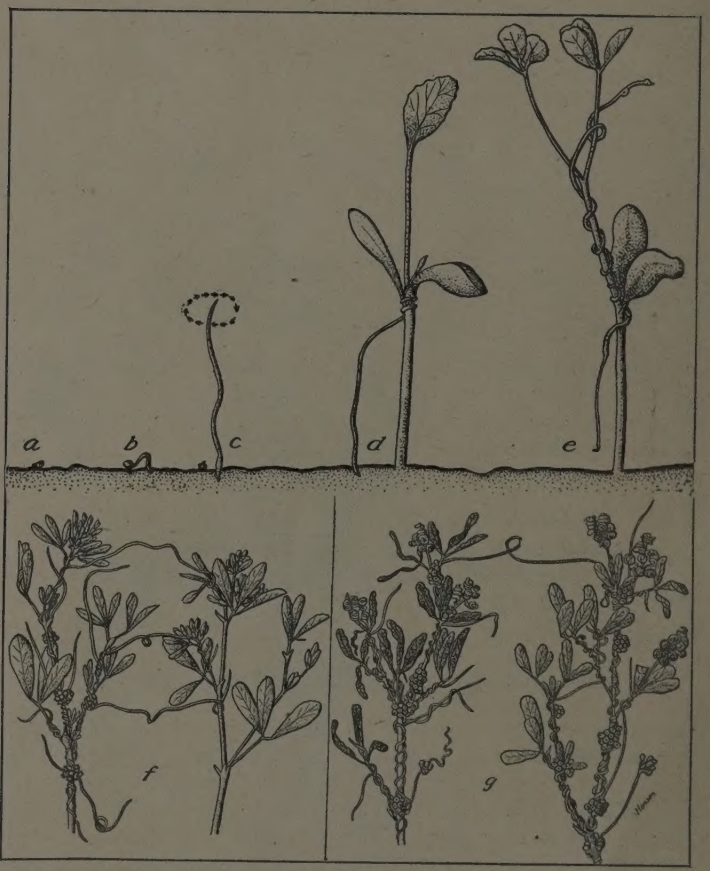

FIG. 4.—Diagrammatic representation of the complete life cycle of dodder on alfalfa plants. *a*, The seed. *b*, Germination of the seed. *c*, Young dodder seedling, showing manner of rotation. Unless the seedling comes in contact with a suitable host plant it will perish. The usual host is a legume, such as clover or alfalfa. Note the remains of the seed coats on the ground. *d*, The dodder seedling in contact with a suitable host plant (in this case, an alfalfa seedling) has wound itself around the stem of the host. *e*, Soon after contact, the dodder sends minute "suckers," termed haustoria, into the host tissues, which sap nutrition from the host plant. Note especially the characteristic withering of the lower portion of the dodder stem, which has now lost all connection with the ground. The dodder has climbed to the upper portions of the host, with which it will continue to grow until the alfalfa either matures or is killed previous to maturing. *f*, The originally infested alfalfa plant is shown at the left. Both the alfalfa and the dodder are in flower. The dodder tendrils have secured a hold upon an adjacent alfalfa plant previously not infested. *g*, The dodder and the alfalfa plants have now matured seed, although the presence of the dodded seriously interferes with the production of seed on the part of the host. The originally infested alfalfa plant (at the left) has withered and is almost dead, owing to the effects of the dodder. The death of the host also kills the dodder, but the parasite continues to live on the more recently infested host at the right, although this newer host likewise is showing signs of wilting. The dodder thus lives on by passing from one plant to another, while the seed carries the parasite over winter, to germinate the following spring and so start a new life cycle.

for example, that the host is clover. The dodder obtains its nutrition by sinking minute suckers, termed haustoria, into the food-conducting tissues of the clover (fig. 6), thus extracting elaborated food, which is utilized by the dodder in growth. These suckers actually secrete a substance called diastase, which dissolves the starchy substances in the host. The suckers may be considered as tiny roots which, instead of obtaining crude food from the soil, extract elaborated food from the clover. The base of the dodder soon shrivels and dries, thus losing all connection with the ground.

FIG. 5.—The seeds of dodder and red clover. Note the smooth seed coats and conspicuous scars of the red-clover seed and the roughened seed coats of the dodder seeds. Magnified nine diameters.

(Figs. 1 and 4, *e*. The dodder climbs, gaining growth and strength at the expense of the clover upon which it grows. As it reaches the top of the clover, the twisting tips of the dodder reach out and attack adjacent plants (fig. 4, *f*), until a gradually increasing circle of infestation is formed.

Meantime, the clover plants first attacked are usually killed to the roots (fig. 4, *g*) and the dodder upon them also dies, but the dodder on the newly attacked clover at the edge of the infested area keeps alive. During all this time the dodder is ripening seed, which falls to the ground, some of it soon germinating and attacking the young

shoots arising from the roots of the hosts until the clover plants are entirely killed. Half-ripe dodder seeds germinate as readily as those fully matured.

The dodder winters over either by means of seed which lie dormant in the soil or by means of its stems, which are not always all killed by the winter's frost, but may renew growth when the favorable conditions of spring arrive. In Maryland little seed is produced, the dodder living over winter almost entirely by the stems close to the ground.

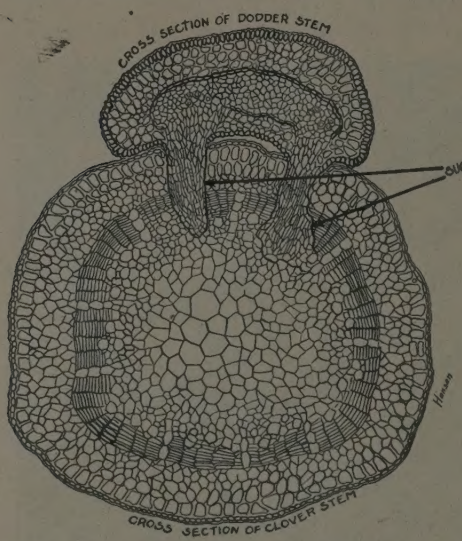

FIG. 6.—Cross section of clover and dodder stems. Note the two "suckers" (haustoria) by means of which the dodder extracts nutrition from the clover. Greatly enlarged. (Original.)

HOW DODDER IS INTRODUCED ON THE FARM.

Dodder may be introduced and disseminated on the farm by any of the following methods.

Impure seed.—Impure seed is by far the most common means of bringing dodder to the farm. This is true not only of domestic seed, but also of European seed. In many parts of Europe it is unlawful to sell clover or alfalfa seed containing even a single seed of dodder; consequently, a great deal of this seed is exported to the United States. This was particularly true before the passage of the Federal law which excludes all commercial seed containing one or more dodder seeds per 5 grams of commercial seed.

Dodder-infested hay.—Not only does hay secured from a dodder-infested field spread the pest by means of the seed, but the scattering of pieces of dodder stems may serve to spread the pest in case they come in contact with suitable hosts. It must be remembered that a piece of dodder branch when freshly cut can cause infestation almost as readily as a seed.

An important consideration in the spread of dodder is its ability to mature seed after it has been cut. An infested hay crop may be

cut when the dodder is just past the flowering stage and the seeds have not as yet apparently matured, but the nutrition contained in the cut plants may frequently be sufficient to enable the dodder to ripen seeds. Furthermore, while dodder-infested hay is being transported, small clusters of flowers and fruit are frequently scattered and serve to spread the weed.

Never use clover or alfalfa seed obtained from a field known to contain dodder.

Moving men and objects.—Farm workers and moving objects, such as wagons and farm animals, occasionally carry dodder seeds, pieces of stems, and clusters of flowers from place to place. Manure containing the seeds of dodder sometimes adheres to the hoofs of animals and to other moving objects, and the weed is scattered by this means.

Irrigation water.—In the irrigated districts of the West, irrigation water frequently carries dodder by means of seeds and pieces of branches.

Infested manure.—Although dodder seeds may pass through the digestive tracts of grazing animals and retain their vitality, the danger from infested manure is somewhat remote unless very fresh manure is used.

HOW TO PREVENT THE INTRODUCTION OF DODDER ON THE FARM.

As with all weeds, and especially dodder, preventing their introduction on the farm is far easier than eradication after they have once gained a foothold.

When animals are allowed to graze where dodder grows, they should not have access to fields not infested, since they are likely to spread the weed by means of pieces of stems adhering to their coats and hoofs.

Dodder may be prevented from entering the farm by observing the following rules:

(1) Do not sow dodder-infested seed.

(2) Do not use dodder-infested hay.

(3) Do not allow animals from a dodder-infested field to have access to dodder-free fields.

(4) Do not allow dodder to grow where irrigation water may carry the pest from place to place.

(5) Do not use farm manure suspected of containing dodder seed until such manure has been composted for a period of at least six weeks.

Of these five rules, by far the most important is the one relative to the use of clean seed.

SUGGESTIONS FOR PROVIDING CLEAN SEED.

Before sowing clover or alfalfa the seeds should first be examined for dodder. This may be done either at home or by sending a sample to the State agricultural experiment station or to the Seed Laboratory of the United States Department of Agriculture. Unless one is familiar with the appearance of dodder seeds, they are difficult to detect, since dodder seeds range in size, according to species, from a grain of sand to that of alfalfa seed, and even larger. For adequate examination a magnifying glass is necessary. By studying figure 5, showing an enlarged view of dodder seed, more can be learned regarding the appearance of the seed of dodder than from

Learn to recognize the appearance of dodder seed. This knowledge is a safeguard against purchasing dodder-infested clover or alfalfa seed on the open market.

pages of description. In general, these seeds are usually dull coated, with roughened or minutely pitted surfaces, and each seed has three flat surfaces, while the seeds of clovers are usually smooth, rounded, and possess a certain luster. Furthermore, the scar on dodder seeds usually is very inconspicuous, whereas the scar on leguminous seeds is clearly evident. Dodder seeds range in color from dark brown to green or yellow. Ability to recognize dodder seed will be found to be valuable when purchasing clover or alfalfa seed upon the market.

CLEANING.

The cleaning of impure seed in large lots is most economically done by seed companies equipped with special machinery for this purpose. On the farm the use of screens is helpful, although the complete removal of dodder seeds is very difficult. The removal of large-seeded dodder from clover and alfalfa seed has been found to be practically impossible. For other kinds of dodder the best results have been obtained by the use of a sieve made of wire having 20 meshes to the inch and of No. 30 to 34 thickness.

In general, home screening to remove dodder seed is at best a difficult and frequently an unsatisfactory procedure. Where the

large-seeded dodder is abundant, it is best to discard infested seed entirely. It is possible to plant such seed so deeply that the dodder will have little chance to come out of the ground, but the danger to future crops makes this practice inadvisable.

If dodder is prevented from seeding during its first season's appearance, the danger of the weed appearing the following year is reduced to a minimum.

Where it is possible to procure from a neighboring farm seed known to be free from dodder, it is frequently better than the kinds of seed purchased on the open market.

KILLING.

A method of killing dodder seeds occurring as an impurity in the seed of clover and alfalfa has recently been devised in Europe and appears promising, but it has not as yet been sufficiently developed to be recommended. This method utilizes heat as a killing agent and consists in dry heating the infested leguminous seed at a temperature which will kill the seeds of dodder but will not harm the clover or alfalfa seeds.

METHODS OF CONTROL AND ERADICATION.

When dodder gains a hold on the farm, a well-planned intelligent system of attack should be formulated and then conscientiously followed. Such a plan should take note of whether the infestation is in spots or widespread and whether or not dodder seed has formed. It is of special importance to prevent dodder from maturing seed.

When dodder appears in small scattered patches, mow these areas before the seed has matured, (1) allowing the mowed plants to dry or sprinkling them with crude oil or kerosene, and burn them, dodder and all, or (2) feed the cut plants for hay.

ERADICATION IN SMALL AREAS.

From six to eight weeks after infested clover or alfalfa seed has been sown, the resulting crop will usually show small scattered patches of dodder occurring throughout the field. Such patches, especially

in a large field, frequently can best be located from horseback. Work should be started immediately to destroy the patches before the dodder gets a good start, and especially before seeds mature, which is frequently as early as July. The patches should be cut close to the ground and the cut plants either burned or removed and used for hay, being careful not to scatter pieces of dodder stems on other parts of the field or on near-by fields.

FIG. 7.—When dodder grows in small scattered areas in the field, each infested spot may be sprayed with oil previous to burning.

In case the dodder seed has ripened, it is best to destroy the patches entirely by burning. Four methods of burning may be used:

(1) Cut the patches with a scythe close to the ground, beginning well out on the margin of the infested area and working in. Allow the plants to dry; then burn.

(2) Sprinkle the infested areas with kerosene, crude oil, or orchard-heating oil, using a common sprinkling can for this purpose. (Fig. 7.) In a few days all the vegetation so treated will be dead. When well dried, ignite.

(3) Cover the infested areas with straw (fig. 8); then burn. (Fig. 9.)

(4) Burn the infested areas with a blow torch. This method is more expensive than any of the preceding.

Whichever method is used, it should always be followed by repeated hoeing of the surface of the infested spots for a period of at least three weeks. The hoeing will induce the germination of any surviving dodder seeds and will also destroy the resulting seedlings. Care should be used to cultivate extremely shallow, in order to prevent the deep burial of viable dodder seeds. Such deeply buried dodder seeds may constitute a constant danger to crops for years to come.

The practicability and efficiency of the burning method are well illustrated by the experience of a grower at Warrenton, Va., who in 1914 requested information from the United States Department of Agriculture as to the best method of treating small patches of clover and alfalfa dodder which had appeared in his fields. He was advised to destroy the patches by burning and followed the advice conscientiously. Since then, according to his own statement, no dodder has appeared in the treated fields.

It is important frequently to inspect the treated areas to see whether all the dodder has been killed. Oftentimes growths of dodder previously unnoticed may occur on near-by clover or alfalfa plants.

FIG. 8.—Small areas infested with dodder may be covered with straw instead of being sprayed with oil.

Burning not only kills the dodder plants but also kills the seeds on the soil. (Fig. 10.) Scattering oil-soaked brush or straw over the ground will usually insure sufficient heat to kill all the dodder seeds on the surface, because the oil will keep the heat close to the surface of the ground.

If clover or alfalfa is to be grown the following year, it is well to mark the treated areas and inspect them during the spring, to make sure that the pest has been completely eradicated.

ERADICATION IN LARGE AREAS.

When dodder occurs either as large patches or covering entire fields, it is usually an indication that the pest had been allowed to

go to seed the previous year. If the dodder has matured seeds, the methods of attack differ from those to be used where dodder seeds have not ripened.

Methods of Eradication in Large Areas Where Dodder Has Not Matured Seed.

It is of extreme importance to attack the dodder before viable seed has formed. Any of the following methods may be used in case dodder seed has not matured.

Early mowing.—Mow the crop, dodder and all, before the dodder has had a chance to seed and then feed the hay to stock, preferably in the field. Animals are not harmed by eating dodder, though horses and cattle will usually reject it in favor of the clover or alfalfa. It is important not to delay the mowing

FIG. 9.—After either covering the infested area with straw or spraying with oil, it should be burned.

too long, since dodder readily matures seed even on a cut crop. Mowing may best be done before any of the dodder flowers have opened. After the hay has been removed, the land may either be plowed and reseeded or else closely grazed in order to prevent the formation of a late crop of dodder seeds.

In the alfalfa fields of the West the common method of handling dodder-infested crops is to mow when the dodder flowers are about to open. After the first mowing the alfalfa stubble is harrowed. The second crop of alfalfa is likewise cut before the dodder has had a chance to mature seeds.

Grazing.—When the dodder plants are first noticed the field may be turned over to grazing animals. For this purpose sheep are particularly good, although hogs or any other grazing animals may be used. The field should be closely grazed during the remainder of the season. Inspection is necessary from time to time, so that no neglected areas of dodder will be allowed to go to seed. A fact to be remembered is that many weeds act as hosts to field dodder and common dodder; hence the fields, and especially the fence rows, should be

kept clean of weeds, in order that the dodder be not carried over from year to year through their agency. This procedure is most important in the States east of the Mississippi River, since in this region the common and field dodders (both of which species commonly attack weeds) occur in greatest abundance.

Plowing.—Plowing the crop under, dodder and all, to be used as a green-manuring crop, is a good way to utilize a dodder-infested legume crop. It is important to make sure that none of the dodder has gone to seed, however, before deciding on the plowing method. In this connection it is well to remember that dodder seeds germinate readily in the early-milk or dough stage.

Methods of Eradication in Large Areas Where Dodder Has Matured Seed.

The menace of allowing dodder to go to seed is due to the fact that the seed remains viable in the soil for a period of five or more

FIG. 10.—The infested area after being burned. Burning not only destroys the dodder plants but also any seeds which were lying on the surface of the soil.

years, thus practically excluding the use of clover and alfalfa for that length of time. In place of clover and alfalfa, soy beans, cowpeas, or velvet beans may be used in some instances, since dodder never damages any of these crops.

When an entire field of clover or alfalfa is infested with dodder and the weed has been allowed to go to seed, the method best suited to conditions should be selected. The various methods which may be employed follow:

Burning.—In extreme cases, where the entire crop of clover or alfalfa has been practically destroyed by the dodder, cut the crop close to the ground and either allow the plants to dry or else sprinkle with kerosene or crude oil. The

crop should then be burned on the ground. The purpose of the burning is not only to destroy all the vegetative parts of dodder, but likewise the seeds lying on the surface of the ground.

Following burning, the land should either be fallowed for the remainder of the season or plowed and planted to a winter cover crop, such as rye or oats. The following spring start a 5-year rotation, beginning with a tilled crop, such as corn or potatoes. During the next four years use a cropping system which does not include either clover or alfalfa. In planning this rotation a selection should be made which includes small grain crops, such as rye, oats, or wheat, tilled crops (like corn or potatoes), and such leguminous crops as soy beans, velvet beans, or cowpeas. Dodder will not attack the

If dodder has been allowed to go to seed in large areas and has practically destroyed the entire crop of clover or alfalfa, the crop should be mowed and burned in order to kill not only the dodder plants but likewise the dodder seeds on the soil surface.

cereal crops, soy beans, velvet beans, or cowpeas, and the stirring of the soil due to cultivation of the tilled crop will tend to germinate any dodder seeds remaining in the soil. Dodder seedlings which may thus result can not survive cultivation; neither will they find suitable hosts to keep them alive. In selecting the tilled crop, the cultivated plants known to be susceptible to dodder should be used guardedly. A list of these susceptible crop plants is given under the heading "Dodder on hosts other than clover and alfalfa." Dodder-infested alfalfa fields in Utah are frequently broken up and planted to sugar beets as a means of cleaning out the dodder, even though it is known that sugar beets are susceptible to dodder attack. The continuous hoeing and cultivation which sugar beets receive during the growing season are con-

A dodder-infested crop of clover or alfalfa may be cut for hay and fed directly from the stacks in the field.

sidered the best methods of ridding the ground of the dodder pest. In case it is particularly desirable to grow clover or alfalfa during the 5-year period following the seeding of dodder, the clover or alfalfa should be closely grazed or cut early in order to prevent the maturing of seed of any dodder which may be present.

Utilizing the crop for hay.—In case the alfalfa or clover is worth saving, the crop may be cut for hay and fed directly from stacks on the infested field. In this connection, it should not be forgotten that the resulting manure will contain viable dodder seeds.

The following spring cut the dodder-infested clover or alfalfa for hay just before the dodder has opened its flowers. During the remainder of the season, closely graze the land, so that no dodder will be allowed to mature seed. Similar early-cutting and close-grazing treatment should be given any clover

or alfalfa grown for the following four years, in order to prevent dodder seed from again fouling the land.

Cutting a dodder-infested crop for hay in which the dodder has matured seed is at best a risky procedure, since it not only permits the land to be fouled with the seed of dodder, but likewise involves the serious risk of scattering the weed to many other parts of the farm. The burning method is much safer, but it has the disadvantage of necessitating the destruction of an entire crop and is to be recommended in extreme cases only.

On land known to contain the seeds of dodder, use a 5-year cropping system consisting of plants which are immune to the attacks of the pest. The following plants are not susceptible to injury by dodder: Corn, soy beans, velvet beans, cowpeas, and small grains, such as oats, wheat, and rye.

CHEMICAL MEANS OF ERADICATION.

Various chemical sprays, such as solutions of iron sulphate (15 per cent), copper sulphate (5 per cent), sulphuric acid (1 part, concentrated, to 200 parts of water), salt, crude carbolic acid, sodium nitrate, and potassium sulphate, have been recommended for use against dodder. These chemicals are not only costly but are expensive to apply, and their application requires considerable labor of a disagreeable character. For these reasons, the use of chemical plant poisons as a means of controlling dodder is not ordinarily to be recommended. Furthermore, other methods are equally efficient and are usually more economical.

Dodder frequently matures seed after the crop upon which it is growing has been cut; therefore clover or alfalfa infested with dodder should be cut before the dodder flowers open. If this is done the dodder will not be likely to mature seed.

DODDER ON HOSTS OTHER THAN CLOVER AND ALFALFA.

INFESTATION OF CULTIVATED PLANTS.

Although the greatest damage due to dodder is in clover and alfalfa, various other crops are sometimes attacked. Among these crops, damage by dodder has been most frequently observed in the following cases:

Sugar beet.—In some sections of the country, particularly in Utah, beets have been damaged by dodder; severe infestations, however, are not common.

Dodder in sugar beets is usually confined to small areas and the damage is not heavy.

Flax.—Several years ago flax dodder[10] caused a great deal of damage in the flax-growing centers of the United States. So serious was the problem that the growth of flax was at one time discontinued in North Carolina, owing to the ravages of the weed. During recent years, however, very little damage has been recorded from this source, owing in part to the use of seed which was free from dodder impurity.

Cultivated plants infrequently attacked by dodder.—Among the cultivated plants subject to dodder infestation, but which, comparatively speaking, are infrequently attacked are grapevine, hemp, carrot, parsnip, turnip, bird's-foot trefoil, raspberry, cucumber, thyme, tobacco, eggplant, crape myrtle, willow, and the succulent parts of rose seedlings, the chrysanthemum, balsam, privet, and other garden ornamentals.

Treatment of dodder on crop plants.—In field and garden crops dodder seems to disappear in the process of regular crop rotation and thorough cultivation. When the infestation becomes sufficiently serious, the most practical solution seems to be to grow crops, such as corn and the small grains, which are not subject to attack by dodder. After four or five years of such treatment the dodder should be sufficiently cleaned out to allow the return to beets, etc.

Infestations of garden plants are rarely sufficiently bad to warrant special methods of eradication. In extreme cases the simplest remedy is to grow other garden plants in the place of those liable to attack.

DODDER ON WILD PLANTS.

A large number of wild shrubs and herbs serve as hosts to various species of dodder. These wild plants include willow, aster, goldenrod, four-o'clocks, ragweed, nettle, purslane, yellow trefoil, pigweed, sunflower, caltrop, wild carrot, shepherd's-purse, hazel, chondrilla, dandelion, viburnum, marsh elder, fleabane, horse nettle, honeysuckle, and several species of wild grasses.

It is of passing interest to note that dodders have actually been known to attack themselves, sinking suckers into their own tissue.

DANGER TO CULTIVATED PLANTS FROM WILD-PLANT HOSTS.

Usually the species of dodder growing upon wild shrubs, with the exception of common dodder and field dodder, will not attack any of our common farm crops. The danger of such attack, however, is always present on newly cleared land on which dodder grew. This fact was demonstrated by an interesting case of dodder infestation which was recently observed in Pennsylvania. A field of eggplants about half an acre in extent was planted on newly cleared woodland.

[10] *Cuscuta epilinum.*

The eggplants became badly infested with dodder; so bad was the infestation that not a single fruit was formed on the parasitized plants, and the entire field was destroyed. The dodder was determined as hazel dodder,[11] a species not uncommon on hazel and other wild shrubs and on tick trefoil and other wild herbs, but never previously reported on cultivated plants.

The incident suggests that when woodlands infested with dodder are cleared, it is well to plant the land to crops known to be immune to attacks of dodder.

Most of the species of dodder commonly found along the edges of woodland adjacent to cultivated land are harmless and should not cause alarm. It is well to have such species identified, however, to be sure of their harmlessness. Specimens may be sent for identification to State agricultural experiment station or to the United States Department of Agriculture.

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[11] *Cuscuta coryli* Engelm.

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